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VEGETATIONAL COMPLEXITY AND PARASITISM OF GREEN PEACH APHIDS (*MYZUS PERSICAE* (SULZER) (HOMOPTERA: APHIDAE)) ON COLLARDS

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Abstract.—In 1978–1979, parasitized green peach aphids (GPA) were recovered from collards in adjacent weedy and weedless habitats. During each season, 22 percent of GPA were parasitized, primarily in weedless plots wherein *Diaeretiella rapae* comprised 94 percent of primary parasitism. Parasitism by *Aphidius* spp. was concentrated on GPA from collards in weedy plots. Secondary parasitism occurred much more frequently in weedless plots, wherein 59 percent of primary parasitoids were parasitized. Secondary parasitoids were: *Asaphes lucens* (53 percent of all parasitoids recovered), *Aphidencyrtus aphidivorus* (34 percent), *Alloxysta* nr. *megourae* and nr. *discreta* (7 percent), *Phaenoglyphis ambrosiae* and n. sp. (3 percent), *Dendrocerus niger* (3 percent) and *D. incompletus* (<1 percent); *A. lucens* was more abundant in 1978 than 1979 while the reverse was noted in *Alloxysta* spp. Secondary parasitoids were evidently attracted to higher densities of primary hosts on collards located in weedless plots.

Influence of vegetational complexity on interactions between parasitic Hymenoptera and their hosts is a subject of ongoing interest. A widely-held tenet is that added environmental complexity may impart stability to otherwise disequilibrial systems. Such increased complexity may be spatial heterogeneity (Huffaker, 1958), addition of predators (Paine, 1966), vegetational diversity (Pimentel, 1961) or some combination of these. In agricultural production there is increasing interest in development of minimum-tillage systems that increase complexity by encouraging the growth of ground cover. Little information exists on the effects of reduced tillage on insect host–parasitoid interactions. The present study reports initial results on the effects of weed cultivation on parasitism of green peach aphids (hereinafter GPA) by Aphidiidae (Hymenoptera) on collards (*Brassica oleracea* var.) in central Ohio. Weeds were expected to provide greater availability of alternate hosts and nectar sources for adult parasitoids. Van Emden (1963) found densities of Ichneumonidae to be higher in weedy than in tilled plots, and Copland (1979) noted reduction in secondary parasitism of hop aphids when weeds were eliminated. I (Horn, 1981) found that densities of aphidophagous Coccinellidae, Chrysopidae, and Syrphidae were higher on collards surrounded by unmanaged weeds despite lower densities of GPA there. When weeds were regularly trimmed to 10 cm maximum height, predators moved to more dense populations of GPA on adjoining weedless collards. In the present study I therefore expected that primary and secondary parasitism on GPA might increase when weeds were uncontrolled.

METHODS

Fieldwork was conducted on the Horticultural Farm, Ohio State University. Collards (var. "Georgia", Ferry-Morse Seed Co.) were started in a greenhouse, and during early May were transplanted into a 9 m × 28 m area outdoors. Transplants were 50 cm apart (later thinned to 1 m) in 1 m rows. The experimental area was subdivided into 8 4 m × 7 m plots. Plots were tilled weekly by machine and hand. The other 4 plots were untilled; the ground cover 1 July was *Amaranthus retroflexus* L. (65 percent) and *Chenopodium album* L. (20 percent) with scattered *Xanthium strumarium* L., *Portulaca oleracea, Polygonum* spp., and grasses.

Four randomly-selected collard plants per plot were sampled weekly from 15 May through 20 July 1978. I counted all GPA and collected all parasitized mummies into gelatin capsules (#000) which were held at 25°C and 15 hr photophase for emergence of parasitoids. Mummies from which had emerged Chalcidoidea or Cynipoidea were dissected to verify evidence of secondary parasitism. Voucher specimens of each species were deposited in the Ohio State University Collection of Insects.

Overhead sprinklers irrigated the area when necessary. Surrounding areas were planted to onions, squash, melons and tomatoes, which were treated heavily and repeatedly with carbaryl and malathion. This may have limited immigration of GPA and parasitoids from adjacent crops.

In 1979 I followed similar procedures except as follows: Weeds were trimmed weekly to a maximum height of 10 cm, and weedless plots were kept free of weeds by black plastic placed over the soil surface between rows. Plots were 4 m × 8 m, and sampling continued through August. Major weeds in 1979 were grasses (60 percent), *Chenopodium album, Cirsium* spp., *Ambrosia artemisiifolia* L., and *Polygonum* spp. The experiment was located in a community garden with local and intermittent insecticide application, probably allowing immigration of GPA and parasitoids from nearer sources than in 1978.

RESULTS

Figure 1 indicates abundance of living aphids on collards in weedy and weedless plots. All aphids were GPA except late in 1978 when there was a small influx of cabbage aphids (*Brevicoryne brassicae* L.). Cultivated collards, contrasting with either bare soil or black plastic, were more readily colonized by alate GPA (Horn, 1981) and their higher intensities on weedless collards reflect this. Subsequent production of apterous GPA resulted in significantly higher total intensity of functioning aphids on weedless collards especially in 1979.

Eleven species of parasitic Hymenoptera were recovered from mummified GPA during this study. *Diaeretiella rapae* McIntosh accounted for 94 percent of all primary parasitism. It is a solitary, cosmopolitan endoparasitoid of many species of crucifer-infesting aphids (Read et al., 1970). Figure 2 shows seasonal trends in primary parasitism on GPA within weedy and weedless subplots. In 1978, there appeared no significant difference in percent parasitism between habitats, though total parasitism was higher on weedless collards, where more hosts were present (Fig. 1). *Aphidius* spp. were recovered almost exclusively from weedy collards. In 1979, these trends were more pronounced; parasitism was very low on GPA from weedy collards.

Figure 3 depicts secondary parasitism on *D. rapae*. Table 1 lists the complex of

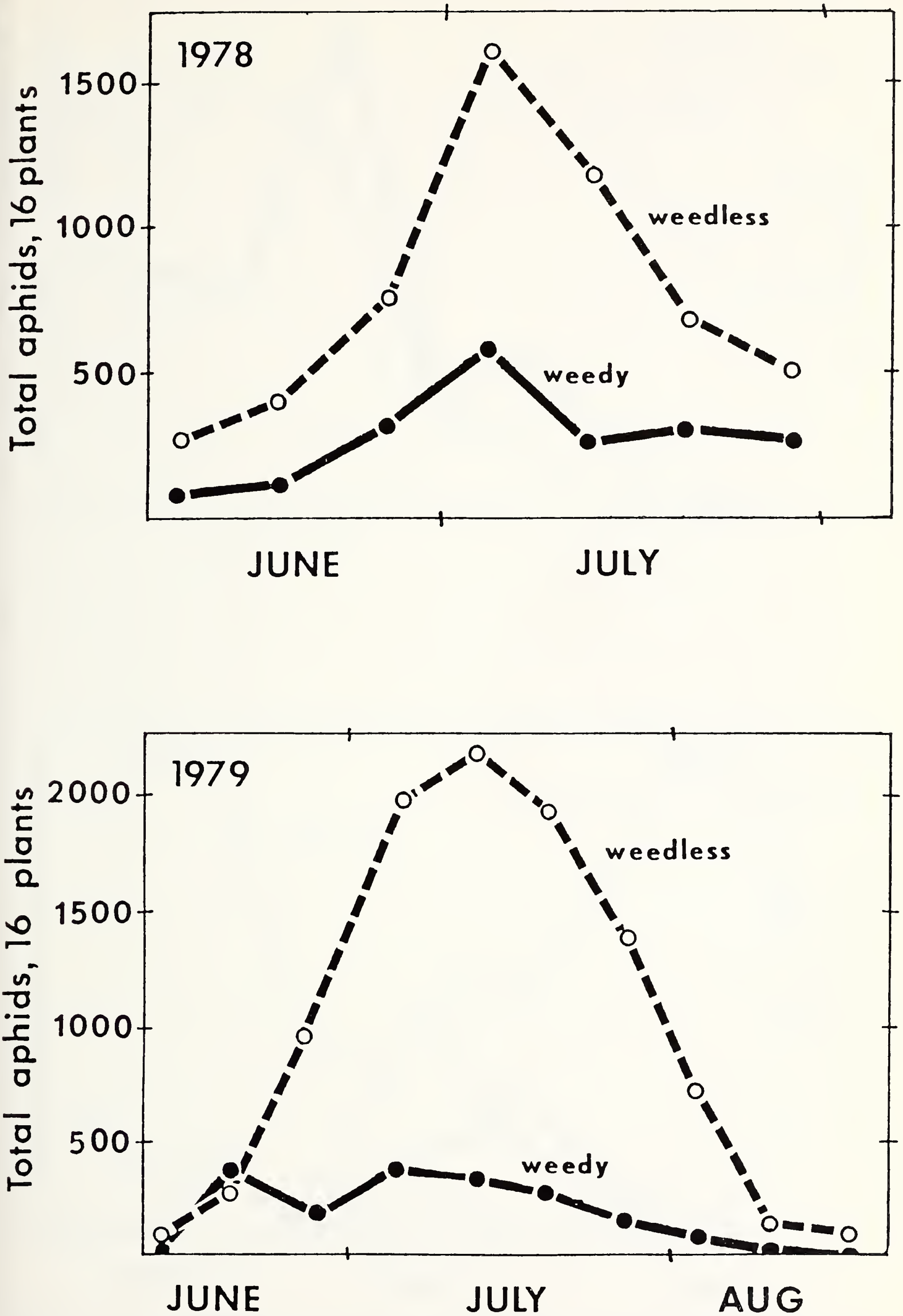

Fig. 1. Total living *Myzus persicae* on weedy and weedless collards, Columbus, Ohio. 1978: weeds not trimmed. 1979: weeds trimmed to 10 cm tall.

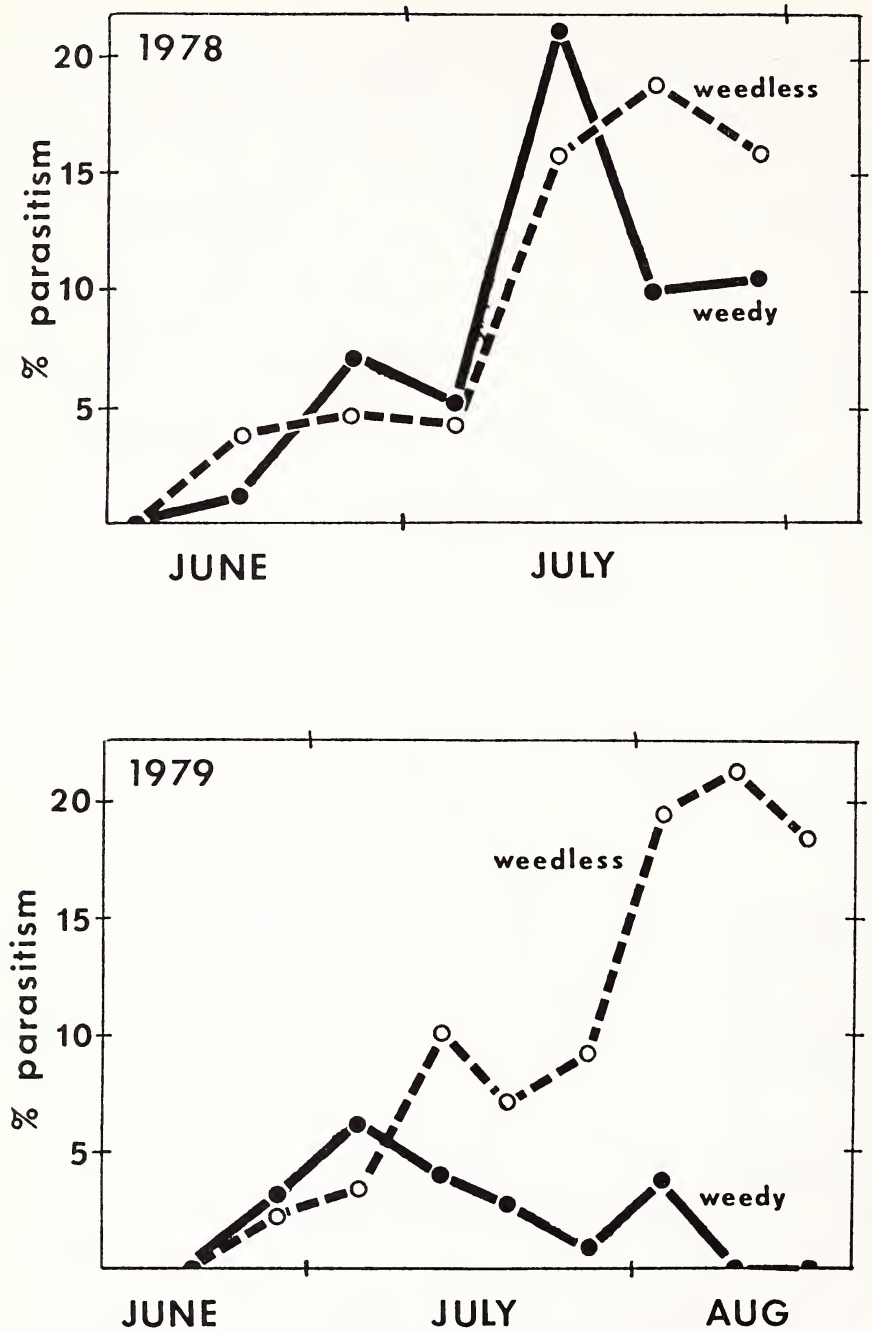

Fig. 2. Percent parasitism by Aphidiidae on *Myzus persicae.* Proportion of parasitism due to *Diaeretiella rapae* in weedy, 84 percent in 1978, 98 percent in 1979; in weedless, 100 percent each year.

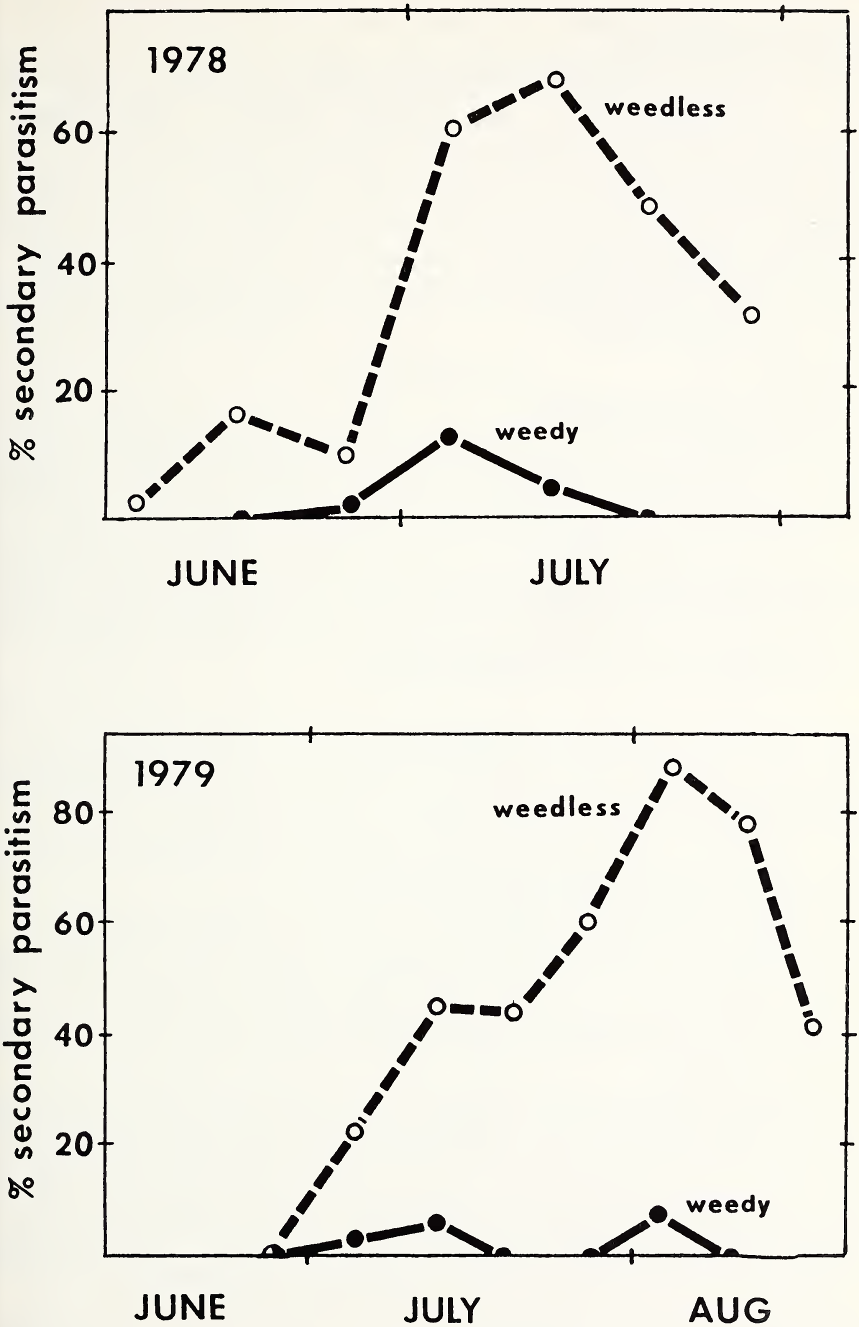

Fig. 3. Percentage of Aphidiidae secondarily parasitized on weedy and weedless collards.

Table 1. Secondary parasitoids recovered from parasitized mummies of green peach aphid, Columbus, Ohio, 1978–1979.

Parasitoid	1978 Weedy	1978 Weedless	1979 Weedy	1979 Weedless
Pteromalidae				
Asaphes lucens Provancher	17	209	12	209
Encyrtidae				
Aphidencyrtus aphidivorus Mayr	2	58	0	226
Alloxystidae				
Alloxysta nr. *megourae* (Ashmead) *Alloxysta* nr. *discreta* (Foerster)	0	16	0	39
Phaenoglyphis spp.	0	2	0	20
Megaspilidae				
Dendrocerus incompletus Muesebeck	0	0	0	4
D. niger (Howard)	1	6	0	23
Totals	20	291	12	521

secondary parasitoids. The secondary parasitoids occurred primarily in weedless habitats. There was little seasonal succession in the complex, except that *A. aphidivorus* was earliest to arrive (mid-June) and Alloxystidae and *Dendrocerus* spp. were limited to when GPA was most abundant (July).

DISCUSSION

The greater intensity of GPA on weedless collards apparently reflects the ease with which the plants are located. Their contrast with backgrounds of bare soil or black plastic enhances their attractiveness to colonizing GPA. The weedy plots harbor a variety of aphidophagous predators whose activity serves to further depress GPA populations on collards in weedy plots (Horn, 1981).

The complex of parasitoids reported here is similar to that found elsewhere on *Brassica* (Chua, 1977; Takada, 1976a, b) and other crops regardless of vegetational complexity (Copland, 1979; Jones, 1979; Sullivan and van den Bosch, 1971; van den Bosch et al., 1979). Usually there are a few species of Aphidiidae, one or two dominant secondary parasitoids (often *Asaphes* or *Alloxysta*), and several minor secondary parasitoids.

In my experiments parasitism of GPA by *D. rapae* was concentrated on weedless collards, especially when weeds in adjacent plots were trimmed (1979). Proximity of weedy and weedless plots may have permitted these widely-ranging parasitoids to quickly locate, and concentrate oviposition on, GPA populations of higher intensity on weedless collards. Parasitism by *Aphidius* spp., by contrast, occurred mostly in weedy plots, where alternate hosts were available, especially on *Chenopodium*. Despite a greater diversity of primary parasitoids, a lower percentage parasitism resulted, at least in 1979, on GPA in the vegetationally more diverse habitat.

Secondary parasitoids occasionally parasitize one another (Bennett and Sullivan, 1978; Griswold, 1923), so that estimates based on rearing may not accurately reflect the relative abundance of searching parasitoids in the field. However, excepting *A. lucens,* there was very little secondary parasitism of Aphidiidae on collards in weedy plots (Table 1). Higher GPA densities on collards in weedless plots led to increased primary parasitism which in turn supported higher secondary parasitism and a more diverse array of parasitoids. The proximity of plots may have contributed, as relatively mobile insects could cross the 1m gap rather easily. Higher densities of parasitized GPA concentrated an attractive resource for secondary parasitoids. Root (1973) found diversity of all Hymenoptera to be higher in collard monoculture than on collards planted within an old-field habitat. Vegetational complexity, therefore, might dilute the apparency of primary parasitoids such as *D. rapae* rather as it hides collards from colonizing GPA.

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